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TECHNICAL NOTE

U.S. DEPARTMENT OF THE INTERIOR
Bureau of Land Management

U.S. DEPARTMENT OF AGRICULTURE
U.S. Forest Service

WILD, FREE-ROAMING BURROS - AN ANNOTATED BIBLIOGRAPHY

by Mark Zarn, Thomas Heller and
Kay Collins, Research Biologists
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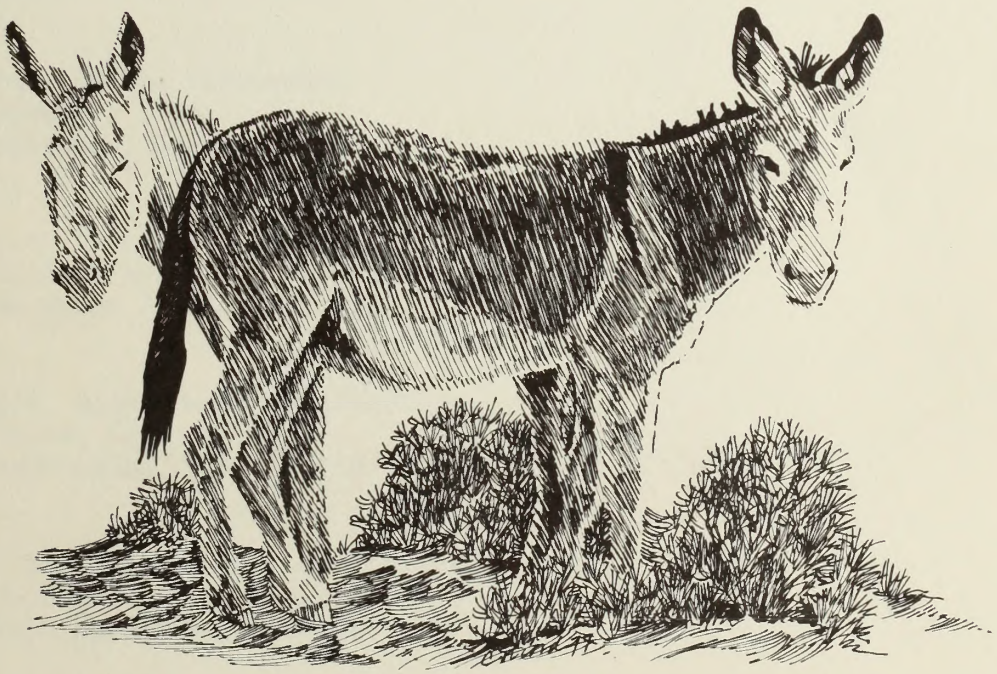

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INTRODUCTION

The purpose of this bibliography is to provide personnel of the U.S. Forest Service and U.S. Bureau of Land Management with a comprehensive annotated list of articles, books, manuscripts, etc. on Wild Burros. Because of the limited information available specifically on Wild Burros, much of the information included in the bibliography is from articles on domestic Burros or from data on other members of the Equidae.

The bibliography is divided into sections for easier use and within each section alphabetically by author.

At the end of each citation a code appears in parentheses giving the location of publication availability. Many of the articles will also be available at local public and university libraries.

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EQUINE SCIENCE

Alexander, F. 1963. Digestion of the horse, p.259-268. In: D.P. Cuthbertson, ed. Progress in Nutrition and Allied Sciences. Olive and Boyd, Edinburgh. (DPL)

A review of available literature on horse digestion, this article covers gastric digestion, mechanics of gastric digestion, digestion in the small intestine, digestion in the large intestine, pharmacological studies, and microbiology. Extensive list of references.

Bell, Richard H.V. 1971. A grazing ecosystem in the Serengeti. Scientific American. 225(1):86-93. (DPL)

This study examines the migration and grazing patterns of three species of large herbivore (wildebeest, zebra, and Thomson's gazelle) in the Serengeti National Park. The animals make use of the herb layer in a regular sequence: first the zebras graze and trample the coarser, stemmier vegetation, they are followed by the wildebeest who in turn prepare the area for the delicate, selective grazing of Thomson's gazelle. Analysis of the stomach contents of the three species revealed that the selected vegetation corresponded to their position in the grazing sucession. The reason for this sequence of grazing is due to the differences in the digestive systems of ruminants and non-ruminants and body size which has an effect on their rate of metabolism. If this grazing succession broke down there is a possibility that the Thomson's gazelle might not be able to survive.

Berliner, Victor R. 1959. The estrous cycle of the mare, p.267-289. In: H.H. Cole and P.T. Cupps, eds., Reproduction in Domestic Animals. Academic Press, N.Y. (DPL)

This paper is divided into five parts. Part I is concerned with the breeding season of mares; part II the pattern of the estrous cycle; part III the physiological and histological changes in the reproductive system; part IV the behavioral pattern of the cyclic mare; and part V the adaptations of the breeding program to cyclic events. The author discusses and comments on the inconsistencies as well as areas of agreement within the literature on the estrous cycle of the mare.

Blakeslee, Jodean Kay. 1974. Mother-Young Relationships and Related Behavior Among Free-Ranging Appaloosa Horses. M.S. Thesis, Idaho State University. 113 p. (DPL)

Approximately 125 free-ranging Appaloosa horses in Idaho were studied by direct observation in a 5,000-acre pasture from June through August, 1973. The horses were also observed at a 3,000-acre winter pasture in Idaho. The author discusses the following areas: the estrus cycle,

gestation period, changes just prior to parturition, foaling, post partum activity, imprinting, bringing the foal into the group, nursing, recumbency and resting, recognition, foal elimination, foal grazing and drinking, foal's exploratory and investigative behavior, and relationships between foals and other group members. A well-documented study with a thorough list of references.

Bone, Jesse F. 1964. The age of the horse. Southwest Veterinarian. 17(4):269-272. (DPL)

A descriptive article which tells how to determine the age of a domestic horse by examining its teeth. Guidelines are included.

Burkhardt, J. 1947. Transition from anestrus in the mare and the effects of artificial lighting. Journal of Agricultural Science. 37:64-68. (DPL)

Anestrus mares were divided into four treatment groups. The Group I mares received an additional period of artificial light. Group II mares were exposed to ultraviolet light which was gradually increased during a four-week period. The light was applied only to their flanks and bellies and their eyes were hooded. Group III mares were kept in confinement under normal light conditions. Group IV mares were allowed to run in the paddock. In Group I ovarian stromal growth, increased vascularity of the cervix and vagina, plus shedding of the coat occurred within 15-30 days from the start of treatment. Follicles appeared soon after and the first appearance of estrus occurred about 30 days earlier than in the other groups. The author concluded that light affects reproductive activity in the mare and, since irradiation of the ovaries with ultraviolet light did not change the normal occurrence of estrus, he suggested that the eye was probably the receptor organ.

Clegg, M.T. and W.F. Ganong. 1969. Environmental factors affecting reproduction, p. 473-488. In: H.H. Cole and P.T. Cupps, eds., Reproduction in Domestic Animals. Academic Press, New York. (DPL)

The authors review the evidence of the role of environmental factors in the reproductive physiology of individual domestic animals. Discussion is grouped under four headings: light, temperature and humidity, social stimuli, and other factors. The introduction covers these four factors as they relate to the available evidence on the various species that have been studied. The specific animals include horse, rabbit, sheep, cattle, swine, and goat. Most of the evidence on the horse concerns the effect of light on the estrus cycle of the mare and its effect on the quantity and quality of semen from the stallion. The authors state that the specific effects of temperature on reproductive acitvity in the mare have not been critically studied. Extensive references.

Bullard, R.W., D.B. Dill and M.K. Yousef. 1970. Responses of the burro to desert heat stress. J. Appl. Physiol. 29(2):159-167. (DPL)

Two female burros (ass, donkey) were studied with regard to regulation of sweating and responses to dehydration and rehydration under the natural desert conditions of Boulder City, Nevada, in July. Sweat in the donkey appeared to be expelled in cycles of 2 or less per minute which occur synchronously all over the body surface. The sweating rate was determined by both central and skin temperatures. Cooling the major portion of the skin area during sweating appeared to reduce the magnitude of cycles, but not the overall sweating rate until general body cooling had occurred. However, heat applied locally to the skin or sweat glands had a marked stimulating effect suggesting that the local temperature of the gland is important in its function and that reflex regulation of sweating, acting by way of peripheral thermal detectors, is less important. The most potent stimulating agent upon intradermal injection was epinephrine. Other autonomic agents were almost completely ineffective upon the rate of sweating. Moderate dehydration, amounting to 14% and 9% of body weight during desert exposures, did not greatly alter blood concentrations, performance, or temperature regulation. Rehydration was rapid and precise after this degree of dehydration. - Biological Abstracts

Ensminger, M.E. 1951. Horse Husbandry. Interstate Printers and Publishers, Danville, Illinois. 336p. (DPL)

A horseman's reference book presented as a high school or college textbook. The book covers types, classes, breeds, selecting and judging, age, breeding, feeding and disease of equines.

Estes, Richard D. 1974. Zebras offer clues to the way wild horses once lived. Smithosonian. 5(8):100-107. (DPL)

The paper is based on the findings of the social behavior study on Burchell's zebras done by the ethologist Hans Klingel over a three-year period in Africa. It describes in detail the family social organization of the zebras. The article is written for a general audience and is scientific in scope.

Feist, James Dean. 1971. Behavior of Feral Horses in the Pryor Mountain Wild Horse Range. M.S. Thesis. Univeristy of Michigan. 129p. (DPL)

"The objectives of this study were to investigate the behavior patterns, social organization, and population structure of the wild horses of the Pryor Mountains, Wyoming-Montana. To facilitate an accurate account of the population structure and social organization, the entire herd on the Range was identified as individuals. Documentation of daily and seasonal activity patterns, movements, possible

home ranges and/or territories, dominance interactions, leadership, and breeding relationships was made. Qualitative and quantitative descriptions and photographs of stereotyped behavior acts were taken." Behavior patterns were analyzed and compared to the behavior of other Equidae from other geographical locations.

Glover, J. and D.W. Duthie. 1958. The nutritive ratio/crude protein relationships in ruminant and non-ruminant digestion. Journal of Agricultural Science, 50:227-229. (DPL)

The author determined that the nutritive ration of animal food was significantly related to the crude-protein content of that particular food in both ruminant and non-ruminant digestion. This confirms that a relationship exists between the total crude protein and digestible protein in ruminant feed. It also strongly suggests that there should also be a relationship between these two proteins in non-ruminant feeds. The author warns that it would be unwise to assume a constant relationship between the nutritive ratio and the crude protein content of feed until more data are available on non-ruminants at low-protein levels.

Hafez, E.S.E., M. Williams and S. Wierzbowski. 1962. The behaviour of horses, p.370-396. In: E.S.E. Hafez, The Behaviour of Domestic Animals. Williams and Wilkins, Baltimore. (DPL)

The article discusses six areas of horse behavior: ingestive and eliminative behavior, activity, social behavior, sexual behavior, schooling and training, and atypical behavior. Scientific in scope and illustrated. List of references.

Hafez, E.S.E., M. Williams and S. Wierzbowski. 1969. The behaviour of horses, p.391-416. In: E.S.E. Hafez, The Behaviour of Domestic Animals. Williams and Wilkins, Baltimore. (DPL)

The article discusses six areas of horse behavior: ingestive and eliminative behavior, activity, social behavior, sexual behavior, schooling and training, and atypical behavior. Scientific in scope and illustrated. List of references.

Hall, Ron. 1972. Wild Horse: Biology and Alternatives for Management, Pryor Mountain Wild Horse Range. Bureau of Land Management, Billings District. 67p. (DPL)

"Population dynamics, distribution and behavior data were collected on the horse herd in the Pryor Mountains, Montana. Population data were collected by aging and sexing 124 horses. Additional sex data were collected by using a spotting scope. Distribution and behavior

information was collected through observations for one year. Distribution of the horses is dictated by water, forage and weather conditions. The horses have seasonal home ranges but do not establish territories. Home ranges vary in size with the size being dependent upon available forage. Breeding season seems to be a function of the green-up which brings mares into heat. Average harem group is three to four (3.4) animals. Range trend has been sharply downward for several years. Management will consist of population control and proper distribution. Distribution will be accomplished by water manipulation and/or feeding."

Hanauer, Elsie. 1973. The Science of Equine Feeding. A.S. Barnes, New York. 78p. (DPL)

Beginning with a complete explanation of the horse's digestive system and its functions, the author delves into basic food requirements, vitamins and minerals. Factors influencing feeding principals, special cases, changing the diet, and feeding schedule are then discussed. A section on specialized diets is followed by a section covering diseases caused by faulty nutrition.

Klingel, Hans. 1965. Notes on the biology of the plains zebra Equus quagga. East African Wildlife Journal. 3:86-88. (DPL)

The author observed thirty-nine harem groups and 15 stallion groups for one year, for a total of about 500 animals. The results of the study are outlined in the following sections: social structure, seasonal distribution and foaling, foaling rate and intervals, sex ratio, and age at sexual maturity.

Klingel, Hans. 1971. A comparison of the social behaviour of the Equidae, p.124-132. In: V. Geist and F. Walther, eds., The Behaviour of Ungulates and its Relation to Management. IUCN Publications new series No. 24. International Union for Conservation of Nature and Natural Resources, Morges, Switzerland. (DPL)

In the Equidae two types of social organization have evolved. The plains zebra (Equus quagga); mountain zebra (E. zebra), horse (E. przewalskii) and possibly also the Asiatic wild ass (E. hemionus) live in coherent family groups, consisting of one stallion, with one to several mares and their young. Surplus stallions are found in stallion groups. The young leave their original families in a set pattern. No territories are established in these species. In the Grevy zebra (E. grevyi) and the wild ass (E. africanus) the stallions maintain large territories which they, however, only defend under certain conditions, i.e., when an estrus mare is near the boundary. Apart from the mare-foal relationships there are no personal bonds between any two or more individuals. Most of the equine populations live in areas with marked seasonal variation.

In the non-territorial species the reproductive groups migrate as units. In the territorial species the sexes segregate for part of the year, a feature which will certainly influence the reproductive rate, especially in areas with irregular rainfall.

Klingel, Hans. 1972. Social behavior of African Equidae. Zoologica Africana. 7(1):175-185. (DPL)

Two basically different forms of social organization were discovered in the equids. Type one is represented by the plains zebra, Equus quagga and by the mountain zebra, E. zebra. Type two comprises Grevy's zebra, E. grevyi and the wild ass, E. africanus. Differences are found between these two groups in territorial and family behavior patterns. The evolution of equine sociology is discussed.

Maloiy, G.M.O. and C.D.H. Boarer. 1971. Response of the Somali donkey to dehydration: Hematological changes. Amer. J. Physiol. 221(1): 37-41. (DPL)

The donkey can tolerate the same degree of water loss from the body (30%) as sheep and camels. A dehydrated donkey can drink, within 2-5 min, 20-30.1 of water to repair such a deficit. A study was made of the effects of dehydration and rehydration on various blood parameters in 5 donkeys and 3 Zebu steers. Increases in plasma osmolality, Na, Cl, Hb, packed cell volume (PCV), red blood cells (RBC), and plasma proteins were observed in dehydrated animals. Neither dehydration nor rehydration had any observable effect on mean cell Hb (MCH). This remained at 22 pg (10-12 g) and 16 pg for the donkey and the Zebu steer, respectively, under all experimental conditions. In the donkey, decreases in mean cell volume (MCV) and in intracellular and extracellular water were observed (ICFV, ECFV). Plasma volume (PV) was also reduced from a mean control value of 9.6 to 6.2 liters. Most of the blood parameters were restored to their normal values within 24 hr. after the animals were rehydrated. -Biological Abstracts.

Maloiy, G.M.O. 1970. Water economy of the Somali donkey. Amer. J. Physiol. 219(5):1522-1527. (DPL)

"Water balance, food intake, volume, and concentration of urine and changes in body weight were examined in the Somali donkey subjected to heat stress and dehydration. The effects of an ambient temperature of 22° C or changes between 22° and 40° C at 12-hr. intervals and a level of dehydration causing 15% loss of body weight at each of these temperatures on food intake and digestion were investigated. Dehydration at each environmental temperature depressed food intake and increased apparent digestibility of dry

matter, but a periodic heat load without dehydration had no effect on either parameter. The animal's appetite failed altogether when 20-22% of its initial body weight had been lost. Fecal and evaporative routes were the main avenues of water loss in all experimental conditions. Evaporative water loss was reduced by 65 and 52%, respectively, when animals were dehydrated at 22° and 22-40°C. The donkey can survive a loss of water corresponding to 30% of its original body weight even at an ambient temperature of 40°C, and can drink in 2-5 min enough water (24-30 liters) to restore its deficit. Even when water was freely available, urine volume was low (0.7-1.2 liters/day). The donkey's kidney was not able to excrete a highly concentrated urine. When the donkey was offered various concentrations of NaCl solution as its sole source of drinking water, the maximum level accepted by the animal was 0.75-1.00% NaCl."

Maloiy, G.M.O. 1973. The effect of dehydration and heat stress on intake and digestion of food in the Somali donkey. Environ. Physiol. Biochem. 3(1):36-39. (DPL)

"The changes in intestinal digestion of the Somali donkey due to both a simulated desert environment (Exposure for 12 hr at 22°C (dry bulb) and 18°C (wet bulb), followed by a further 12 hr period of exposure to an ambient temperature of 40°C (dry bulb) and 24°C (wet bulb), referred to here as 22-40°C condition, and to a stress condition consisting of a water restriction up to a 15% level of dehydration (with and without heat load) were investigated. Dehydration at both environmental temperatures (22°C and 22-40°C), separately, depressed food intake and increased apparent digestibility of dry matter, but an intermittent heat load as found in the desert environment per se had no effect on either parameter."

Odberg, Frank Olof. 1973. An interpretation of pawing by the horse (Equus caballus), displacement activity and original functions. Saeugetierkd Mitt. 21(1):1-12. (DPL)

The original function of pawing was as part of the nutritive and grooming behavior and as the marking of territory. Pawing was also interpreted as displacement activity; by the sight of unreachable food, while eating, while waiting before work (racing, pulling the cart), by the stallion before serving the mare, and as part of the threat-expression.

Orcutt, Edalee. 1947. Wild horses couldn't drag me. Zoonooz. 20(3):6-7. (DPL)

The author describes the Somali Ass: he is "from ten to twelve and a half hands high, with small hoofs, the forward pair no larger than the hind pair, and has distinctive long floppy ears." Markings include black barring on the lower leg but lacks the transverse shoulder

stripe, which is an almost universal characteristic of domestic breeds. The Somali has only five lumbar vertebrae instead of the six found in most equines.

Schmidt-Nielsen, Knut. 1964. The donkey, p.81-93, In: K. Schmidt-Nielsen, Desert Animals; Physiological Problems of Heat and Water. Oxford University Press, New York. (DPL)

"The donkey has not been much used as an experimental animal and the generalizations given below are tentative because they are mostly based on observations of a single animal. The donkey has, when no water is used for heat regulation, a rate of water expenditure of about 2½ times that in the camel. In summer, whan water is used for heat regulation, the rate is 3 to 4 times as high as in the camel. The main reasons for the higher rate of water loss in the donkey are (a) the fluctuations in body temperature are smaller than in the camel, (b) the fur coat is thinner, and (c) the behavioural adaptations which reduce heat gain are not as extreme. The donkey, like the camel, has an exceptional tolerance to dehydration of the body, being able to withstand a water loss of 30 per cent of the body weight. The donkey eliminates rather large amounts of faeces because the food is not as well digested as in ruminants. The water content of the faeces is also relatively high, resulting in a faecal water loss some three times that in the camel. The urine volume is also higher than in the camel. The available information indicates that plasma volume is relatively well maintained as dehydration progresses. This may be one of the explanations for the high tolerance to water depletion. The drinking capacity of the donkey is impressive, it can ingest in a few minutes more than one-quarter of its body weight in water. The drinking seems adjusted to a restoration of the water content to the normal level, and over-hydration has not been observed."

Short, C.E. and P.R. Welch. 1965. Observations on the effects of a fertility management program on the fertility of the burro. Vet Med. 60: 634-636. (DPL)

"A three year study to evaluate the effects of a fertility management program in a herd of 125 female burros indicated that the low fertility level and irregular estrous cycle of the burro contribute to breeding problems. Treatment of infected burros with Mixed Equine Bacterin (Norden), Furacin Solution (Eaton) and Valsyn Gel (Eaton) increased the probability of conception and decreased the mortality rate of newborn foals."

Smythe, R.H. 1966. The Mind of the Horse. Stephen Greene Press, Brattleboro, Vermont. 123p. (DPL)

The author, a veterinarian, describes the horse's instincts as a herd

animal, and cites the adjustments it is required to make in carrying out patterns of behavior entirely opposed to its natural impulses. Then he examines the horse's sensory advantages and handicaps. His chapter on vision examines the make-up and placement of the eye in various breeds and, with the aid of excellent diagrams and photographs, explains how a horse's actions are governed by what it is able to see. Equally enlightening are his sections on equine hearing, smell and taste, tactile sensations, emotions and motivations.

Smythe, R.H. 1967. The Horse: Sturcture and Movement. 2nd ed. Revised by Peter C. Goody. J.A. Allen, London. 184p. (KSU)

The author discusses the anatomic structures which are responsible for the appearance of the horse and the relationship of musculo-skeletal system to movement. The book is divided into four sections: bones and joints; skin and surface contour of the body; functions of certain parts of the horse at rest and in motion; and an appendix. Text is supplemented with illustrations.

Stecher, Robert M. 1962. Lateral facets and lateral joints in the lumbar spine of the horse--a descriptive and statistical study. American Journal of Veterinary Research. 23(96):939-947. (DPL)

Large size in an animal poses muscular disadvantages for locomotion. In the horse and other animals this is compensated for by stiffness of the posterior spine. Stability in the horse is augmented by lateral joints in the lumbar region. These lateral joints are unique to all horses, domestic, wild, or prehistoric. The joints vary from four to seven with the number largely dependent on the length of the lumbar spine which is dependent upon the number of lumbar vertebrae. The author examined 245 skeletons of members of the horse family and found variation in all breeds and species. The sources of skeletal material by breed and species are listed. The functions of the lateral joints are discussed. The text includes photographs and tables. Included is a summary in Spanish.

Tyler, Stephanie J. 1972. The behaviour and social organization of the New Forest Ponies. Animal Behavior Monographs. 5(2):85-196. (DPL)

The author spent a total of 3948 hours observing the actions and behavior of the New Forest ponies during the years 1965 to 1968. The New Forest covers an area of 144 square miles in Britain of which 103 square miles are under public ownership. The ponies are believed to be descendants of small wild horses indigenous to Britain and are semi-wild; except for the annual harvest of young animals and the control of stallion numbers they remain free to forage for themselves throughout the year. Particular attention was paid to the structure and stability of the groups, the dominance-subdominance relationships within and

between groups, and the relationships between mares and their foals. Observations were also recorded on the daily maintenance activity of the ponies such as grazing, resting, grooming and elimination.

Waring, G.H. 1971. Sounds of the horse (Equus caballus). Paper read before the meeting of Ecological Society of America. September 21, 1971. (DPL)

"Horses produce a variety of sounds. Among these are squeals, nickers, whinnies, groans, blows, snorts, snores, and sounds associated with coughing, chewing, flatus, hoof beats, and sheath movements. Many, if not all, could act in information transfer between horses and facilitate social interactions. Furthermore because of the symbiotic relationship between man and horse, the sounds of the horse function at times in inter-species communication aiding in transfer to a human handler information about the emotions of the horse, thus facilitating the symbiotic relationship."

Yousef, M.K., D.B. Dill and D.V. Freeland. 1972. Energetic cost of grade-walking in man and burro, Equus asinus: desert and mountain. Journal of Applied Physiology. 33(3):337-340. (DPL)

"In the desert at 800 m altitude, 695 mm Hg, men and burros walked on grades of from 0-17% without a load or with a load equal to 25% of the subject's body weight. Walks on the 17% grade were made also at high altitude, 3,800m, 485 mm Hg. The energetic cost of walking determined by measuring O_2 consumption (Vo_2) for each set of conditions was higher in man than burro. The net Vo_2/kg was the same for load or no load in man and burro on all grades. The advantage of the burro over man walking upgrade was even greater walking downgrade. The energetic cost of climbing a vertical meter was only 9 and 14% higher in man than burro; however, the cost of walking a horizontal meter required twice as much energy for man than for the burro. The superior economy of the burro in the desert was evident at 3800 m altitude. In the burro as in man the cost of walking was unchanged at altitude. The economy of the burro was due to its anatomy and mechanics of walking. The lower cost of walking in the burro was of major importance to his survival in hot deserts." - Biological Abstracts.

Yosef, M.K. 1970. Shifts in body fluids during dehydration in the burro, Equus asinus. J. Appl. Physiol. 29(3):345-349. (DPL)

The mechanisms underlying the exceptional tolerance to dehydration in the burro are not fully understood. A study was conducted using 2 burros to partition body fluid compartments before and after dehydration. Dehydration for 48 hr including a 1 hr. walk reduced body weight about 18%. Intracellular fluid volume (ICFV) decreased from 77.9 to 52.9L, extracellular fluid volume (ECFV), from 53.2 to 45.8L, and

plasma volume (PV), only from 9.0 to 8.4L. The ability of the burro to conserve blood volume and presumably to maintain circulatory adequacy gives a likely explanation of its well-being even after 20% dehydration. Man and burro walking at the same rate in the desert sweat approximately at the same rate in relation to surface area. The difference in water loss between 2 dehydrated nonexercising burros is found to be behavioral and partly related to the time spent in the sun. Rehydration was rapid and overhydration did not occur. Water content of feces of dehydrated burros was similar to that of desert antelopes but greater than values reported on the camel's feces. -Biological Abstracts.

GENERAL

Beebe, B.F. and J.R. Johnson. 1964. American Wild Horses. David McKay Company, Inc., New York. 180p. (DPL)

A juvenile book explaining many aspects of the lives of wild horses and burros including how they can be utilized after capture. The book is illustrated with line drawings.

Brookshier, Frank. 1974. The Burro. University of Oklahoma Press, Norman. 370p. (DPL)

"The ass, the donkey, the onager, the koulan--the burro. All are names for one of the world's most used and abused beasts of burden. If the horse was the animal of conquest, it was his cousin, the lowly burro, who made it possible for civilization to spread to the far reaches of the earth. He brought wood to the fires, raised water from the wells, toiled in the fields, carried the great and the poor, followed the conquistadors to the New World, packed for the prospector and the miner. According to many historians, civilization as we know it would never have reached its present stage without the services of this intellignet, patient, strong-backed little animal. The Burro is an eloquent and appealing account of the animal's past and present, including many famous individuals, among them Brighty of Grand Canyon and Jimenez' imortal Platero. The book has 150 illustrations and a chapter for those who would like to join the fast-growing ranks of persons who own pet burros."

Dobie, J. Frank. 1952. The Mustangs. Little, Brown, Boston. 376p. (DPL)

A highly anecdotal history of the wild horses of the American West, examining the theories of their origin, and relating incidents of their capture and use by both Indians and whites. A comprehensive presentation of the horse's introduction, spread, influence, zenith and disappearance. Thorough documentation and extensive list of references.

Groves, Colin P. 1974. Horses, Asses and Zebras in the Wild. Ralph Curtis Books, Hollywood, Florida. 192p. (DPL)

"The author describes wild horses and their relatives in detail--their different varieties, habitats, how they live, their prospects of survival, and also a history of those species now extinct."

Haines, Francis. 1971. Horses in America. Crowell, New York. 213p. (DPL)

A popular historic survey on the various types of horses found and bred in America for different purposes. The early history of the horse in America and how it spread is outlined. A modest list of references.

Howard, Robert West. 1965. The Horse in America. Follett Publishing Company, Chicago. 298p. (DPL)

A brief survey of the role of the horse in North American culture and history. The author carries the story from Eohippus up to today's leisure-time riding and racing horses. He discusses the roles of Conquistadores, Indians, the military, cattlemen, and various other groups in the horse's history in this country.

Hutchins, Paul and Betsy Hutchins. 1973. The Donkey and Mule as a Backyard Hobby. Hee Haw Book Service, Denton, Texas. 81p. (DPL)

"A book for those people who are new to donkeys and mules... to help people get started with a new hobby, and to help those who already started, learn more." The following areas are covered, complete with illustrations: types and burros; buying your donkey; environment; feeding the donkey; grooming, care of the feet, health; tack; training and using; having fun with your donkey; showing the donkey; jennets and foaling; jacks, mares and mules; and breeding and saddle mule.

Leadabrand, R. 1956. Long-eared problem child of the desert. Desert Magazine. June:10-12.

The article outlines and discusses two opposing attitudes concerning burros. One side says that the burro helped make the west what it is today and is entitled to respect and protection. Others hold the view that the burro in reverting to the wild, is taking the forage that properly belongs to the native wildlife of the region. Legislation protecting the burro in California is outlined and a history of how the wild burro became extablished is given. (DPL)

McKnight, Tom. 1957. Feral burros in the American Southwest. Journal of Geography. 56:315-322. (DPL)

"Results of a detailed mail-questionnaire, supplemented by field interviews and observations, indicate that there are between 5500 and 13,000 feral burros existant today in the western United States. They are found in parts of 10 states, with principal concentrations in southeastern California, western Arizona, and Southern Nevada. The burros usually inhabit rugged terrain, can subsist on almost any vegetation, and are subject to very little predation. Thus, depletion of the range by overuse and deliberate control by man are the principal factors limiting the growth of the burro population. Frequently the presence of feral burros is detrimental to the range, water holes, and other herbivorous animals. The major problem is competition for food and water with desert bighorn and with livestock.

McKnight, Tom L. 1958. The feral burro in the United States: distribution and problems. Journal of Wildlife Management. 22(2):163-179. (DPL)

"Results of a detailed mail-questionnaire, supplemented by field interviews and observations, indicate that there are between 5500 and 13,000 feral burros existant today in the western United States. They are found in parts of 10 states, with principal concentrations in southeastern California, western Arizona, and Southern Nevada. The burros usually inhabit rugged terrain, can subsist on almost any vegetation, and are subject to very little predation. Thus, depletion of the range by overuse and deliberate control by man are the principal factors limiting the growth of the burro population. Frequently the presence of feral burros is detrimental to the range, water holes, and other herbivorous animals. The major problem is competition for food and water with desert bighorn and with livestock. The writer recommends 9 steps to provide for more satisfactory burro management." T.L. McKnight.

National Advisory Board for Wild Free-Roaming Horses and Burros. Proceedings. Irregular. U.S. Dept. of Agriculture, Forest Service, and U.S. Dept. of the Interior, Bureau of Land Management, Washington, D.C. (USDA, USDI)

The proceedings of the National Advisory Board which contain current information on pending legislation and lawsuits, recommendations of the Board, population status of wild horses and burros, current management reports of the Bureau of Land Management and Forest Service and other pertinent material.

Ryden, Hope. 1970. America's Last Wild Horses. Dutton, New York. 311p. (DPL)

A history of America's horses, from origin to original extinction, reintroduction by the Spanish, use by the Indians, up to the present, including commercial exploitation and lack of protection. The author describes the political struggle for and against protection of herds and gives opinions on steps necessary to prevent the extinction of wild horses today.

Simpson, George Gaylord. 1951. Horses: The Story of the Horse Family in the Modern World and through Sixty Million Years of History. Oxford University Press, New York. 247p. (DPL)

A scientific survey based on a project of the American Museum of Natural History, tracing the evolution of the horse from pre-historic forms to the present. The standard reference book on horses. The book is illustrated with line drawings and has an extensive list of references.

Willson, Roscoe G. 1957. Will it be life or death for Arizona nightingales? Arizona Days and Ways Magazine. March:38-39. (DPL)

This article was prompted by a bill introduced into the Arizona State Senate to protect wild burros in that state. The author states that the burro has been cited by biologists for competition with desert bighorn sheep but the same biologists report that the number of bighorn is steadily increasing and occasional hunting of bighorn is allowed. The only problem caused by burros is that they "frequently congregate around desert water holes, and for a time, at least, prevent cattle, bighorn and other wildlife from watering." The author favors some sort of protection for burros.

Wyman, Walter D. 1945. The Wild Horse of the West. Caxton Printers, Caldwell, Idaho. 348p. (DPL)

This book places primary emphasis on events since 1890, but goes back to the original introduction of horses by the Spanish. It maintains that distribution of horses to Indians was primarily by means of northward movement of Spanish strays. It details the influence of horses on Indians and stockmen up to the present time.

Zeuner, Frederick E. 1963. Ass and Mule, A History of Domesticated Animals. p.374-383. In: F.E. Zeuner, Hutchinson, London.

A definitive coverage of the earliest known domestications of the horse and ass, concentrating on their development in different geographical areas. The articles are scientific and well-documented with extensive bibliographies. (DPL)

LEGISLATION

Anonymous. 1953. California's wild burros given legal protection. Outdoor California. 14(20):2. (DPL)

Legislation passed by the California Legislature places wild burros on the protected list for two years. The act prohibits shooting of feral burros, violators are subject to a maximum fine of $1,000 or a jail sentence of one year, or both. A "wild burro" is defined as one "not tamed or domesticated for a period of three years after its capture."

Koehler, James W. 1960. The California undomesticated burro. Bulletin of the California State Department of Agriculture. Jan.-Feb. 1-6. (DPL)

The California burro, Equus asinus, originated from the Somali wild ass, Equus asinus somalicus. They live from 25 to 40 years and were imported to America in the 16th century. A discussion and map outline the burro populations in California. The author mentions problems of competition between the burro and other animals including domestic livestock for food and water. A history of California legislation concerning the burro is outlined. In 1939 a law was passed prohibiting the capture of an undomesticated burro for the purpose of using the carcass for animal food. In 1953 an amendment to the 1939 bill was passed which made it unlawful to kill undomesticated burros for any purpose. In 1957 the burro became State property and possession could be had by citizens only for the purpose of domesticating and using them as pets or beasts of burden. A sanctuary was established along with a permit system for those wanting to capture burros. Problems with implementing the legislation are discussed.

Leadabrand, R. 1957. Burro sanctuary on the Mojave. Desert Magazine. December:5-7. (DPL)

The passage of California State Senate Bills 31 and 32 provides a large burro sanctuary (6,000 square miles) in Inyo County and extends current protective legislation for the burro. The sanctuary includes almost all of Death Valley National Monument and the State legislation does not affect operation of the feral burro management program within the monument. The protective law makes California the owner of all feral burros in that state. It prohibits killing, wounding, capturing or possession of any undomesticated burro. Those wishing to capture an undomesticated burro for a pet or pack animal can do so by obtaining a permit from the California State Department of Agriculture. The law also allows owners and tenants of land being damaged or destroyed by burros to apply for a permit to kill them.

Public Law 86-234. 1959. Statutes at Large, Vol. 73, p.470. (DPL)

An amendment to the United States Code, Chapter 3 of Title 18, which

prohibits the use of aircraft or motor vehicles to hunt certain wild horses or burros on land belonging to the United States, and for other purposes.

Public Law 92-195. 1971. Statutes at Large, Vol. 85, p.649-651. (DPL)

A law requiring protection, management, and control of wild free-roaming horses and burros on public lands. This law places all wild free-roaming horses and burros under the jurisdiction of the Secretary of the Interior or the Secretary of Agriculture.

U.S. Congress. House. 1959. Amendment of Title 18, United States Code, To Prohibit the Use of Aircraft or Motor Vehicles to Hunt Certain Wild Horses or Burros on Land Belonging to the United States. House Report 833 to accompany H.R. 2725, 86th Congress, 1st session. (DPL)

This is the House report concerning H.R. 2725, a bill to prohibit the use of aircraft or motor vehicles to hunt certain wild horses or burros on lands belonging to the United States.

U.S. Congress. House. 1971. Protection, Management, and Control of Wild Free-Roaming Horses and Burros on Public Lands. House Report 681 to accompany S. 1116, 92nd Congress, 1st session. (DPL)

A conference report concerning the disagreement between the House and the Senate regarding S. 1116, a bill requiring the protection, management, and control of wild free-roaming horses and burros on public lands.

U.S. Congress. House. 1971. Requiring Protection, Management and Control of Wild Free-Roaming Horses and Burros on Public Lands. House Report 480 to accompany H.R. 9890, 92nd Congrss, 1st session. (DPL)

The House's report concerning H.R. 9890, a bill to require the protection, management, and control of wild free-roaming horses and burros on public lands.

U.S. Congress. House Committee on Interior and Insular Affairs. 1971. H.R. 795 and H.R. 5375, Legislation to Authorize the Protection, Management, and Control of Free-Roaming Horses and Burros on Public Lands. Hearings before a subcommittee of the Committee on Interior and Insular Affairs, House of Representatives, on H.R. 795, H.R. 5375 and Related Bills, 92nd Congress, 1st session. (DPL)

Testimony concerning legislation designed to authorize protection, management, and control of free-roaming horses and burros on public lands.

U.S. Congress. Senate. 1959. Wild Horses and Burros. Senate Report 802 to accompany H.R. 2725, 86th Congress, 1st session. (DPL)

The Senate's report report concerning H.R. 2725, a bill to prohibit the use of aircraft or motor vehicles to hunt certain wild horses or burros on lands belonging to the United States.

U.S. Congress. Senate. 1971. Protection, Management and Control of Wild Free-Roaming Horses and Burros on Public Lands. Senate Report 242 to accompany S. 1116, 92nd Congress, 1st session. (DPL)

The Senate's report concerning S. 1116, a bill to require the protection, management, and control of wild free-roaming horses and burros on public lands.

U.S. Congress. Senate. Committee on Interior and Insular Affairs. 1971. S. 862, S. 1116, S. 1090, and S. 1119 To Authorize the Secretary of the Interior and the Secretary of Agriculture to Protect, Manage, and Control Free-Roaming Horses and Burros on Public Lands. Hearings before a subcommittee of the Committee on Interior and Insular Affairs, Senate, on S. 862, S. 1116, S. 1090, and S. 1119, 92nd Congress, 1st session. (DPL)

Testimony concerning legislation to authorize protection, management, and control of free-roaming horses and burros on public lands.

U.S. Department of the Interior and U.S. Department of Agriculture. 1974. A Report to Congress by the Secretary of the Interior and the Secretary of Agriculture on Administration of the Wild Free-Roaming Horse and Burro Act, Public Law 92-195. 58p., appendices. (DPL, USDA, USDI)

The report fulfills section 10 of public law 92-195, The Wild Free-Roaming Horse and Burro Act. The review presents the progress made and the problems encountered by these two agencies in their administration of wild horses and burros. It also contains considerations for legislative changes which will assist the agencies in meeting the intent of the 1971 Act in a more effective, humane, and cost-conscious manner. Two amendments to the 1971 Act are being considered. The first amendment would permit the use of aircraft or other motorized vehicles to be used for the protection, management, and control of wild horses and burros. The use of such equipment would be in accordance with humane procedures prescribed by the two secretaries. The second amendment would authorize the two secretaries to sell or donate excess animals to private individuals or organizations. Extensive appendices.

POPULATIONS, HABITAT, AND COMPETITION

Anonymous. 1970. Burro study in Death Valley. American Donkey and Mule Society Journal. November:13. (DPL)

"Patti Moehlman is working toward a doctorate in Behavioral Ecology at the University of Wisconsin by studying the herds of wild burros that live in Death Valley. Her study will help the Bureau of Land Management decide whether or not to establish wild burro refuges in the southern California desert. There are estimated to be 8,000 to 10,000 burros roaming 10 western states with about 1,500 in Death Valley." - Horseman's Abstracts.

Barnes, W.C. 1930. Wild Burros. American Forests and Forest Life. 36: 640-642. (DPL)

The article talks about burros in the west, their uses and how they were rounded up. Of interest is mention of the slaughter of 1,000 burros in the Grand Canyon. The author mentions that very little publicity was given because park officials feared public reaction and pressures that might be imposed. This fear came from previous experiences with horse slaughters.

California. Department of Fish and Game. 1972. Status of Feral Burros in California. California Dept. of Fish and Game, Sacramento. 8p. (DPL)

This article reviews legislation concerning the burro on both state and federal levels. The distribution of feral burros in southeastern California is given. The department states that: "Though specific, and often extensive areas are known in which burros are devasting the range, it should not be assumed that these conditions necessarily prevail on all burro ranges. However, it should be clearly understood that burros present serious problems when left unmanaged. The new federal legislation make it clear that the intent is to preserve the wild, free roaming burros and horses. It must be realized that in so doing they must be managed and kept in balance with the other resources."

Davis, Grace S. 1953. Respite for the burro. Nature Magazine. 46(7):370-374. (DPL)

A general article about the burro written because of passage of legislation in California to protect the burro there. The burro's ability to find water and competition between the burro and other animals is discussed. The author claims that burros, cattle and horses all foul open water holes and springs. The author recounts personal observations of a field trip to see burros.

DeWald, Bud. 1956. A he-man's sport. Arizona Days and Ways Magazine. 8 April:6-9. (DPL)

A brief article with many pictures explaining a burro roundup at a guest ranch. The owner of the guest ranch is promoting the burro roundup because "a regulated burro roundup would hold the burros in balance and provide a great tourist and publicity bonanza."

Dixon, J.S. and E.L. Sumner. 1939. A survey of desert bighorn in Death Valley National Monument, Summer 1938. California Fish and Game. 25:72-95. (DPL)

"The natural water supply in the Death Valley area was found to be considerably greater in 1938 than it had been in 1935 or 1917. There has been a slight but noticeable increase, believed to be from 10 to 15 percent, in the number of bighorn found at the various critical areas visited. The evidence presented by fresh tracks, together with actual counts of individuals, gives a total of approximately 65 bighorns in the 21 areas visited. These areas represent, of course, only a limited portion of the total bighorn range in Death Valley National Monument. Moreover, it is almost certain that weather conditions prevented anything like a complete census, even in the areas covered by us. Most encouraging of all was the fact that no evidence of poaching was found although particular scrutiny was made at Lemonade Spring and at Hanapaugh Canyon, where Dixon had found poaching serious in 1935."

Dodge, Natt N. 1951. Running wild. National Parks. 25:104:10-15.

The author, a naturalist with the National Park Service outlines a trip with two co-workers to eradicate any burros found within Grand Canyon National Park. He explains that the burros came from pack burros that escaped or were freed and because they were so adapted to the environment, being natives of the African desert, they thrived. (DPL)

Farrell, Joel Emmett. 1973. Behavioral Patterns of Feral Burros as Influenced by Seasonal Changes in Western Arizona. M.S. Thesis. Arizona State University. 34p. photos, map. (DPL)

"This study of utilization of waterholes and effects on desert environments by feral burros was conducted in the west-central regions of Arizona. Investigations began in April of 1972 and were concluded in March of 1973. A total of four waterholes, two man-made, the others natural, were used for investigative purposes. Bulk densities of soil; forage analysis of browse plants; and surveys of vegetational damage provided information on the impact of burros on desert environment. Daily observations at waterholes provided information on numbers, time, and seasonal utilization."

Ferry, Philip. 1955. Burro or bighorn? Pacific Discovery. 8(6):18-21. (DPL)

"Park rangers say that wherever the burro and the bighorn have overlapped in their range, the bighorn has invariably been crowded out. The bighorn is a super-sensitive creature that must have a completely balanced range; it has neither the burro's stamina nor that animal's ability to adapt itself to a shrinking range and a diminishing water supply. In any contest between the two, the bighorn must inevitably yield. The burros thrive best from 2,000 to 7,000 feet above the valley floor, the bighorn thrives best from 5,000 feet upward. The controversy must be resolved soon before the burros and bighorns have a detrimental effect upon the range."

Fulwider, Derrel S. 1965. Bakersfield's boom in burros. Our Public Lands. 14(4):14-15. (DPL)

The article talks about the 3,000 burros in the Bakersfield district and their impact on the environment there. Of concern to the author is the ever decreasing amount of forage in the vicinity of waterholes, competition between the burro and bighorn sheep, and competition with domestic livestock. California legislation prohibits killing burros and has established some 2 million acres of public domain land in Saline, Eureka, Panamint and Amaragosa Valleys as a burro sanctuary. Cooperation is needed to properly manage the burro and studies are needed to know how to correctly manage them.

Jones, F. n.d. Competition. Unpublished manuscript. 26p. mimeo. (DPL)

"Significant competition for food and water occur with deer, burros, domestic sheep, cattle, horses, and goats. The fact that bighorn usually occupy rougher terrain affords considerable freedom from competition. However, direct competition has extirpated bighorn from many areas of their original range, and reduced their numbers in others. While burro competition can be severe, these animals are no more anathema to bighorn than any other competitor. Domestic sheep have been the most damaging of man's animals, though cattle have been detrimental also. Bighorn socialize on occasion with deer, cattle, goats, and domestic sheep. Competition exists within bighorn herds, working against the young and the old in times of food or water shortages."

McMichael, T.J. 1964. Studies of the Relationship Between Desert Bighorn and Feral Burro in the Black Mountains of Northwestern Arizona. M.S. Thesis, University of Arizona. 38p. photos, maps. (DPL)

"This study of the relationship between desert bighorn sheep and feral burros was conducted in Warm Springs Canyon of the Black Mountains, Mohave County, Arizona from July 1962 to September 1963. Sheep and burros were located and observed to determine their feeding and watering patterns, their daily movements, and their seasonal distribution.

Samples of the contents of eight sheep stomachs were collected during the 1962 and 1963 sheep hunts through the cooperation of the hunters and the Arizona Game and Fish Department. The Arizona Livestock Sanitary Board issued the permit necessary for collecting nine burros for stomach contents samples. These samples were analyzed for comparative occurence of food items. Sheep and burros were frequently found near the Springs during the summer months. Here they fed on the same plant species, drank at the same times of day, and used the same shade to avoid the heat. "Although no direct harm to the sheep could be attributed to the burros, it is felt that under limiting conditions they could have a negative effect. Author's abstract.

Moehlman, Patricia Des Roses. 1972. Getting to know the wild burros of Death Valley. National Geographic. 141(4):502-517. (DPL)

The author conducted an 18-month study of the burros in the Panamint Range of Death Valley National Monument. This article popularizes several aspects of her study. Her recommendation, based on the study "favors a management program that would retain the burros at a level the area would comfortably support." Her study group inhabited an area of 300 square miles and included 110 adult males, 51 adult females and 50 adolescents and foals.

Moehlman, Patricia Des Roses. 1974. Behavior and Ecology of Feral Asses (Equus asinus). Ph.D., University of Wisconsin. 251p. (DPL,UM)

"The behavior and ecology of feral populations of Equus asinus were studied in the Northern Panamint Range of Death Valley National Monument for 20 months during 1970-1973. Seasonal population size and distribution were determined by individual identification and road, aerial, and watering source censuses....Feral asses were primarily browsers in the Wildrose study area. Individuals drank approximately once every 24 hours during the hot-dry summer....Behavior patterns used in social interactions are described and quantified by sex and age class. Communication signals are classified in four categories: auditory, visual, tactile, and olfactory....Social groups consisted of stable (longer than one week) associations of female with offspring, and temporary (2 hours to 1 week) associations of various composition.. ...Interindividual spacing within social groups was recorded at five minute intervals....Territorial behavior was exhibited by five males... ..Outside of the territory dominance was reflected in relative distance from the estrous female....Reproduction was year round with peaks in natality in May, June, and July....This population may be in the process of selecting for a territorial system."

Ohmart, R. and S. Woodward. 1974. Daily and Seasonal Movements of Feral Burros (Equus asinus) in the Havasu Resource Area, Colorado River Valley, California - Arizona. Unpublished manuscript. 33p. (mimeo). (DPL)

The initial results of a broad-based study aimed primarily at gaining biological information on burros and possible interactions with native wildlife. The early data collected shows that there are broad differences between the Colorado River basin population and those in Death Valley.

Reavley, William. 1974. Wild horse board suggests sweeping changes. Conservation News. 39(22):12-14. (DPL)

The decisions of the National Wild Horse and Burro Advisory Board made at the Reno, Nevada 1974 meeting are discussed. To deal with the increasing populations, the Board's plan was as follows: "A series of 'intensive management units' (or wild horse refuges) would be established throughout representative ranges in the West, with the exact number yet unknown but possibly varying between 10 and 20. The remainder of the wild horse and burro populations not in the designated management areas would then be removed from the balance of the public domain." Vehicles such as helicopters would have to be used to round up the left-over horses and burros and those not claimed would be sold to defray the cost of rounding them up. This plan is in conflict with existing legislation.

Russo, J.P. 1956. The Desert Bighorn Sheep in Arizona. Phoenix: Arizona Game and Fish Department. 153p. (DPL)

"Bighorn sheep range is approximately one-third of Arizona....Early accounts of bighorn sheep in Arizona are few and are mentioned only briefly in historical literature....Animals competing with bighorns were investigated to determine the degree of range deterioration for which each species was responsible and the economic importance of each animal." The author includes a discussion of management recommendations.

Russo, J.P. 1973. Burro Food Habits and Competition. Prepared for National Advisory Board on wild and free-roaming horses and burros. Arizona Game and Fish Department, Phoenix. 8p., (mimeo). (DPL)

The author uses the results of ten studies in different geographical areas to give evidence that direct competion exists between feral burros and the desert bighorn sheep and the desert deer. These three animals utilize many of the same forage plants, many of the same water places and inhabit much of the same habitat. The author recommends control of feral burros to insure proper conservation of the range.

Sanchez, Peter G. 1974. Impact of Feral Burros on the Death Valley Ecosystem. Presented at the Wildlife Society, Western Section Annual Meeting, Monterey, California. February 2, 1974. 20p. (DPL)

The author discusses feral burros in Death Valley National Monument. His paper covers topography and vegetation, wildlife, burro impacts, competition with native animals, vegetation changes, springs, burro

control activities, and management considerations. He concludes: "Damage by feral burros is one of a number of man-caused problems affecting the integrity of a natural ecosystem in Death Valley. To be effective, other habitat management projects such as restoration of former wildlife habitat, rehabilitation of old mining scars, relief of human impact by recreational activity and others, cannot be successful if destructive influences remain. For example, it is of no benefit to bighorn to rehabilitate a spring formerly used by them if burros will move in. It is impractical to revegetate an abandoned mining road if burro impact negates management's efforts. For restorative actions to be assured reasonable success, such actions must be delayed until a primary destructive force is rendered inoperative. If burro control is unacceptable, the public must accept the ecological fact of life that the Death Valley ecosystem will continue to alter until a new equilibrium is reached and native populations will continue to decline significantly. In the long term, this disappearance of some native species can be expected."

U.S. Department of the Interior. Bureau of Land Management. 1974. Livestock Grazing Management on National Resource Lands. Final Environmental Impact Statement. 3 vols. misc. paging. (DPL, USDI)

"This is a programmatic statement relating to the livestock grazing management program administered by the Bureau of Land Management (BLM) and analyzes the environmental impact of this program on the national resource lands (NRL), public lands administered by the Bureau of Land Management. This statement will provide a broad description of, and the alternatives to, the livestock grazing management program, and their impacts on the environment. It will serve as the foundation for subsequent environmental analyses and statements that may be required. It will identify factors needing close attention in such analyses to obtain definitive information." (Note: Because of a pending lawsuit more specific information will be forthcoming in the near future.)

U.S. Department of the Interior. Bureau of Land Management: Susanville District. 1973. Wild Horses and Burros. n.p. (DPL)

A report which evaluates the present horse and burro situations in the Susanville District of California. Based on research of the present populations; including the range condition and competition with other animals, the report recommends the implementation of certain management practices. Populations were determined by use of aerial survey counting techniques.

U.S. Department of the Interior. Bureau of Land Management, Susanville District. 1974. Wild Horses and Burros, Environmental Analysis. 52p. (DPL)

A summary of an 18-month study of the wild horses and burros of the

Bureau's Susanville District in California. The study indicates definate over-grazing and competition problems in that area. Population counts reported were partially determined by aerial surveys. Eight alternative recommendations are made based on the study.

Waver, Roland H. 1974. Feral Burro Management Program for Bandelier National Monument. National Park Service, Southwest Region, Santa Fe, New Mexico. 56p., 4 maps. (DPL)

A plan "to restore and preserve the natural and cultural environment within Bandelier National Monument. In order to accomplish this, a program to reduce and control the feral burro population will be implemented, along with continuing research for the development of a long-range management program and vegetative restoration." The article contains a thorough discussion of burro impact in the Bandelier National Monument.

Weaver, Richard A. 1972. Big Game Investigations, Feral Burro Survey. California Department of Fish and Game. (U.S. Bureau of Land Management, U.S. National Park Service, California Dept. of Agriculture cooperating). Project W-51-R-17. Job: final report. 14p., 7 maps, mimeo. (DPL)

"Seven of the 14 bighorn study areas in California have free-roaming feral burro populations. Burros have created a problem in each of these areas. They compete directly with bighorn for food, space and also water if it is in short supply. Burros have caused devastating damage to the vegetation and soil which has had a detrimental effect on the entire biota. With the knowledge gained during the bighorn investigations the 1968 burro inventory was revised. The present burro population is estimated at approximately 3,400 animals in the state (California)."

Weaver, Richard A. 1972. Desert Bighorn Sheep in Death Valley National Monument and Adjacent Areas. California Department of Fish and Game. Project W-51-R. 20p., 3 maps, mimeo. (DPL)

Competition between desert bighorn sheep occurs in the Death Valley National Monument and adjacent areas. The author observed bighorns and burros at water at the same time but his experience shows that "the burro is the dominant animal and bighorn will wait for burro to leave or bighorn will leave if burro come while they are drinking." Burro populations have increased in the subject area.

Weaver, Richard A. 1974. Feral Burro and Wildlife. Presented at the Vertebrate Pest Conference, Anaheim, California, March 5,6,7, 1974. 15p., mimeo. (DPL)

"Feral burro have caused devastating damage to the vegetation and soil which has resulted in a deterioration of the entire biota. Wildlife

numbers have declined where there is competition with burro for food, water or space. The Department of Fish and Game made a burro survey in conjunction with bighorn investigations. There are an estimated 3,400 free-roaming wild burro in California. They are found in 7 of the 14 bighorn study areas and have caused problems in each of these areas."

Weaver, Richard A., J.L. Mensch and R.D. Thomas. 1969. A Report on Desert Bighorn Sheep in Northeastern San Bernadino County. California Department of Fish and Game. Project W-51-R-14. 26p., map. (DPL)

Competition between desert bighorn sheep and feral burros occurs in northeastern San Bernadino county. According to the report: "Competition between bighorn sheep and feral burros was very evident in many portions of the area surveyed. Severe competition for food and space was observed in the western portion of the Granite Mountains, in the Foshay Pass area of the Providence Mountains and throughout the Woods Mountains. Competition in these areas is already very severe and if left unchecked will probably result in further serious declines in sheep populations. Burros are continually increasing their range and both species cannot be maintained at the present level."

Weaver, Richard A. and J.L. Mensch. 1970. Desert Bighorn Sheep in Northern Inyo and Southern Mono Counties. California Department of Fish and Game. Project W-51-R. 9p., map. (DPL)

Competition between desert bighorn sheep and feral burros occurs in northern Inyo and southern Mono counties. The report says: "Competition with feral burros may be severe in the Hunter Mountain areas and in the lower elevations of the Inyo, Last Chance, Saline and Nelson ranges. These areas are or have been critical as wintering sites particularly during severe winters. Although not fully utilized at the present by bighorn, competition probably was much greater in the past and may have contributed to low population at the present."

Weaver, Richard A. and J.L. Mensch. 1970. Bighorn Sheep in Northwestern San Bernardino and Southwestern Inyo Counties. California Department of Fish and Game. Project W-51-R. 16p., map. (DPL)

Competition between desert bighorn sheep and feral burros occurs in northwestern San Bernardino and southwestern Inyo counties. According to the report: "Competition between sheep and burros appears to be mainly for food and space. Perennial grasses which have been shown to be a prime food for bighorn are depleted in many areas through burro overuse with secondary food plants being heavily used by burros. In addition, food plants in the vicinity of springs which are very important to sheep are overused and trampled by burros."

Weaver, Richard A. and J.L. Mensch. 1969. A Report on Desert Bighorn Sheep in Eastern Imperial County. California Department of Fish and Game. Project W-51-R-14. 16p., map. (DPL)

Competition between desert bighorn sheep and feral burros occurs in the eastern Imperial county, California. Observations showed that there was definite competition for water and probable competition for food around watering holes. The report says: "A reduction in the burro population would allow for a sizeable increase in the sheep population and may allow permanent sheep populations in areas which are now only seasonally used because of lack of water."

Weaver, Richard A. and John Hall. 1971. Desert Bighorn Sheep in Southeastern San Bernardino County. California Department of Fish and Game. Project W-51-R. 26p., map. (DPL)

Competition between desert bighorn sheep and feral burros occurs in southeastern San Bernardino county, California. Direct competition for food, water and space was reported. In the area mentioned on one side of the Colorado River where there is a small burro population, the sheep used the water from the river. On the other side where burro numbers were great, sheep were never observed using the river. The authors say that "Burros are dominant and bighorn sheep will not challenge them even for water."

Welles, R. and B. Wells. 1960. The Feral Burro in Death Valley. National Park Service. 52p. (DPL)

"There are probably less than half the number of burros originally believed to inhabit the monument area. Of the estimated maximum population of 900, we observed 154....The feeding habits and behavior of the burro are not as directly competitive with other wildlife as has been believed. In its preferred habitat the burro is not in significant conflict with other species....Burros and bighorns have been observed feeding in the same area, but with significant topographical barriers of relative ruggedness separating their respective sections of foraging area....The burro does not always totally destroy the cover for other species in spring areas. The watering habits and behavior of the burro are not as directly competitive or destructive as has been believed....The nocturnal watering habit of the burro lessens the direct competition between it and the diurual burro....Without controls the burro population would logically be expected to exceed the carrying capacity of the range within a very short time....There are two important large animals in Death Valley National Monument, the bighorn and the burro. The bighorn, if it had been left alone, would have "managed" itself, but people and the burro have arrived and with them the necessity for the appointment among the species of places to feed, drink, hide, rest, sleep, play, and to raise their young."

Welles, R.E. and F.B. Welles. 1961. The Bighorn of Death Valley. U.S. Fauna Series No. 6. U.S. Department of the Interior, National Park Service. 242p. (DPL)

"The present study was undertaken because very little has been published or known about the day-to-day life history and ecology of the desert bighorn anywhere. It was realized also that studies conducted under the critical environmental conditions of Death Valley might yield findings of a significant and possibly somewhat different nature from those obtained elsewhere. Intensive fieldwork commenced December 18, 1954... ..to March 1, 1961, a total of 1,643 hours was devoted to...uninterrupted series of dawn-to-dusk observations....No single food item can be called a mainstay in the diet of Death Valley bighorn....Available water supplies constitute a mojor limiting factor in bighorn numbers and distribution....A major danger to the future existence of the bighorn lies in a continued and accelerating usurpation of its ancestral water supplies by man. Bighorn appear to prefer to remain in one home area if conditions allow them to, being born, living, and dying within a radius of 20 miles of their home water supply....Man and what he has brought with him comprise the only significant threat to the bighorn survival. The wild burro is part of this picture, but its threat to the bighorn survival is indirect, and present control methods are reducing the threat to a minimum. While all ecological wisdom urges the complete elimination of all exotic species from the biota, it cannot be argued that the burro is eliminating the bighorn, since healthy herds of both species are thriving together on some ranges and have done so for at least 25 years. Only unchecked human encroachment appears actually to threaten the future status of the bighorn."

Wood, Harold William. 1974. Death Valley: desert wilderness in danger. National Parks and Conservation Magazine. 48(2):4-9. (DPL)

The author laments the present situations at Death Valley National Monument. In addition to too many tourists and miners, he complains about too many burros. "Feral burros, offspring of the burros of the early miners trample and graze rare Death Valley grasses and flowers. The feral burros compete with bighorn sheep and other creatures for palatable, edible plants. Burros also muddy up the water holes and defecate in them. Such pollution does not seem to bother the burros, but, bighorn sheep require isolated watering places with clear, clean water. Every year there are more and more burros and fewer sheep."

Wright, George M. 1935. Big game of our national parks. Scientific Monthly. 41(2):141-147. (DPL)

The article discusses endangered animals found in the national parks. Mention is made of the Rocky Mountain Bighorn: "Very little is known concerning the sheep of Grand Canyon. These faded-out desert bighorns, with their very massive, tightly curled hornes, live in the canyon

below the rim, and, in their practically impenetrable habitat, they are seldom seen. It may be assumed, however, that the recent removal of over a thousand feral burros may react favorably upon their food supply and consequently upon them."

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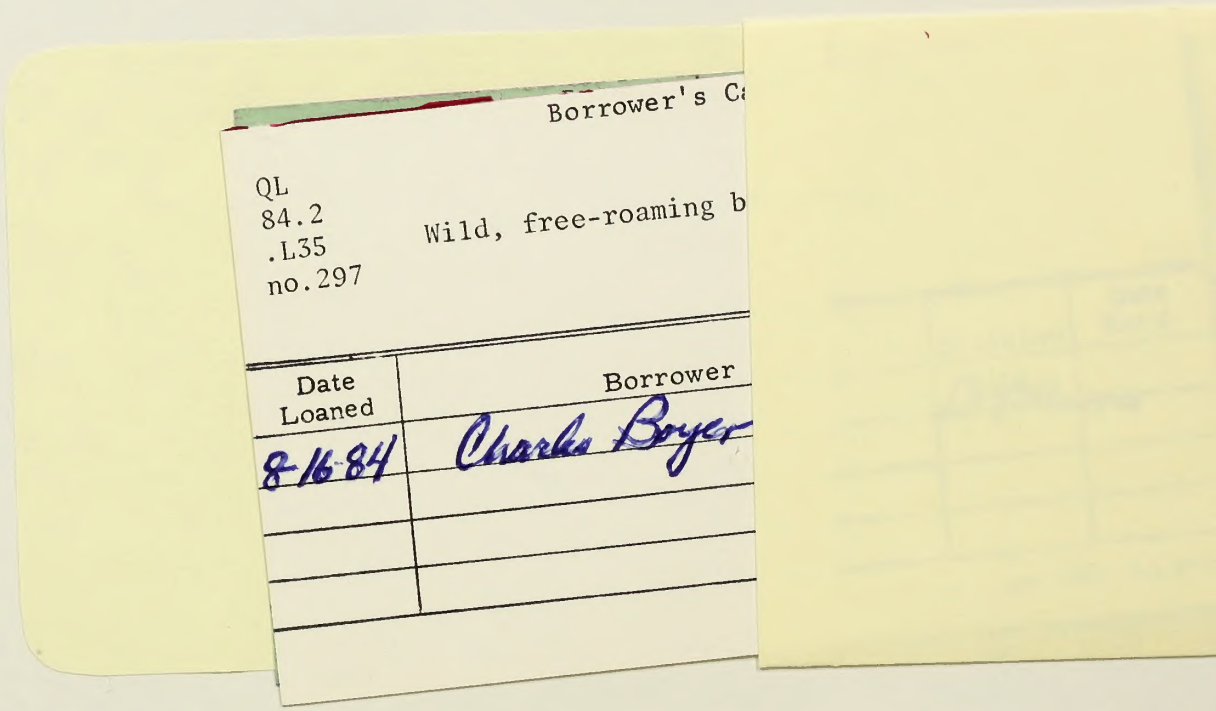
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